(19) World Intellectual Property Organization

International Bureau





(43) International Publication Date 22 September 2005 (22.09.2005)

(10) International Publication Number WO 2005/086669 A3

- (51) International Patent Classification⁷: A61K 39/108, 39/112, 39/00, 39/02, A01N 63/00
- (21) International Application Number:

PCT/US2005/006638

(22) International Filing Date:

28 February 2005 (28.02.2005)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

60/549,306 2 March 2004 (02.03.2004) US 60/604,846 26 August 2004 (26.08.2004) US

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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- (88) Date of publication of the international search report: 30 March 2006

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.





(57) Abstract: The present disclosure describes pathogenic bacteria that have been modified to be deficient in NiFe hydrogenase activity; compositions comprising such modified bacteria, and the use of such bacteria to protect animals from pathogenic enteric bacterial infections.